

PATENT APPLN. NO. 10/531,045
SUBMISSION UNDER 37 C.F.R. § 1.114

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REMARKS

Claim 1 has been amended to delete the limitation "which thin film undergoes an increase in porosity that advances inside from the thin film surface during charge and discharge" and to add the limitation that --a film containing LiF is formed on said divided noncrystalline thin film--.

The limitation that a film containing LiF is formed on the divided noncrystalline thin film is supported by paragraph [0066] of the specification and Figures 3 and 4. Li_2F^+ ion is detected for battery A1 in accordance with the present invention. Applicants submit that it is well known in the art that the detection of Li_2F^+ ion in a TOF-SIMS spectrum such as Figure 3 means that LiF is formed.

Referring to the Final Action of March 16, 2010, claims 1-22 are rejected under 35 U.S.C. § 112, first paragraph, as failing to comply with the written description requirement and are rejected under 35 U.S.C. § 112, second paragraph, as being indefinite.

Each of the 35 U.S.C. § 112 grounds of rejection relates to the recitation formerly in claim 1 of "which thin film undergoes an increase in porosity that advances inside from the thin film surface during charge and discharge". The 35 U.S.C. § 112

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rejections have been avoided by deleting the above-quoted recitation from claim 1.

Claims 1-5, 8-10, 12-17 and 22 are rejected in the Final Action under 35 U.S.C. § 103(a) as being unpatentable over JP 2003-007295 ("JP '295") in view of Ikeda et al., EP 1 231 651 A1 ("Ikeda"), and further in view of Ebner et al., U.S. Patent No. 4,853,304 ("Ebner"), or JP-07-249431 ("JP '431").

Claims 1-5, 8-10, 12-15 and 22 are rejected in the Final Action under 35 U.S.C. § 103(a) as being unpatentable over JP 01-029913 ("JP '913") in view of Ikeda and further in view of Ebner or JP '431.

Claims 6 and 7 are rejected in the Final Action under 35 U.S.C. § 103(a) as being unpatentable over either JP '295 or JP '913, each taken in view of Ikeda and Eschbach et al., US 5,681,357 ("Eschbach").

Claims 18-21 are rejected in the Final Action under 35 U.S.C. § 103(a) as being unpatentable over either Ebner or JP '913, each taken in view of Ikeda and further in view of JP 2000-311706 ("JP '706").

The rejections of claim 1, the only independent claim in the application, are essentially the same rejections that have been made in prior Actions in this application. Each of these

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rejections rely on Ebner or JP '431 as supporting the obviousness of adding carbon dioxide to the non-aqueous batteries of JP '295 and JP '913 to improve cycling efficiency.

Applicants have previously argued that Ebner does not support the rejections because in Ebner, lithium metal is used as a negative electrode material (Col. 2, line 24). Ebner discloses that "it is believed that CO₂ acts as a precursor to form an ionically conductive, protective film on the surface to [sic] the lithium metal which prevents freshly deposited lithium from undergoing parasitic side reactions with the electrolyte solution. It is further proposed that CO₂ could also be altering the morphology of the plated lithium, making it less dendritic in nature." (Col. 4, lines 62 - 68). However, in the case of a silicon thin film as used as an anode in the present invention, deposited lithium and plated lithium are not produced on the negative electrode during charge and discharge cycles. Thus, nothing in Ebner provides any teachings to enable the art-skilled person to reasonably predict the results of adding carbon dioxide to a battery, as in the JP '295 and JP '913 primary references, in which the anode comprises a noncrystalline (amorphous) silicon thin film.

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With respect to JP '431, applicants have previously argued that the purpose and effect of dissolving carbon dioxide in the electrolyte of the battery of JP '431 is to improve the safety of the battery even in the case where a safety valve mechanism is operated in the high temperature environment to blow out the nonaqueous electrolyte (English abstract). JP '431 discloses carbon materials, chalcogen compounds, aluminum, aluminum alloys, magnesium alloys, lithium metal, and lithium alloys as a negative active material (paragraphs [0019] - [0023]). However, JP '431 does not disclose silicon as a negative active material. The effect of dissolving carbon dioxide in JP '431 is obtained by releasing the carbon dioxide having a snuffing action from the nonaqueous electrolyte at the high temperature. JP '431 discloses nothing concerning the effect of the carbon dioxide on the cycling efficiency of the battery. Therefore, like Ebner, nothing in JP '431 provides any teachings to enable the art-skilled person to reasonably predict the results of adding carbon dioxide to a battery, as in the JP '295 and JP '913 primary references, in which the anode comprises a noncrystalline (amorphous) silicon thin film.

In the Final Action of March 16, 2010, the Office argues that Ebner supports a case of prima facie obviousness because Ebner "envisions in column 2, the addition of carbon dioxide to lithium

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secondary batteries that utilize an organic ester solvent in the electrolyte. This is precisely the organic solvent used in the primary reference '295, and so a prima facie case of obviousness has been established." (Final Action, page 5, lines 10-13).

Ebner does not support the conclusion of the Office. Nothing in Ebner suggests that Ebner envisions the addition of carbon dioxide to [all] lithium secondary batteries that utilize an organic ester solvent in the electrolyte.

To the contrary, improvement in cycling efficiency in Ebner is limited to improvement in cycling efficiency of a battery including an organic ester solvent and a lithium anode. Note, for example, the description in Col. 2, lines 59-66, of Ebner that one of the two important factors concerning electrolyte solutions of secondary batteries is "providing for efficient cycling of the lithium anode" (emphasis added) and the description in Col. 4, lines 36-38, of the second key factor for an electrolyte solution in a rechargeable lithium cell as being "to provide for efficient cycling of the lithium anode" (emphasis added). The effect of carbon dioxide in Ebner is described only with respect to a lithium anode and nothing suggests that the effect of the combination of an ester solvent and carbon dioxide would be expected to be exhibited with respect to

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all possible anodes. The lack of such suggestion rebuts the conclusion of the Office regarding prima facie obviousness.

Regarding JP '431, as explained previously, the effect of dissolving carbon dioxide in JP '431 is obtained by releasing the carbon dioxide having a snuffing action from the nonaqueous electrolyte at the high temperature. JP '431 discloses nothing concerning the effect of the carbon dioxide on the cycling efficiency of the battery. Therefore, the result of the addition of carbon dioxide to the nonaqueous electrolyte of the battery of the present invention is an unexpected effect that rebuts any prima facie obviousness asserted by the Office to be supported by the combination of JP '295 or JP '913 with JP '431.

Removal of the 35 U.S.C. § 103(a) grounds of rejection and an allowance of the application are believed to be in order and are respectfully requested.

The foregoing is believed to be a complete and proper response to the Office Action dated March 16, 2010.

In the event that this paper is not considered to be timely filed, applicants hereby petition for an appropriate extension of time.

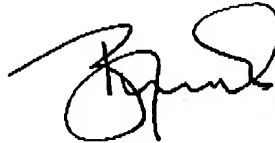
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The fee for any such extension and any additional required
fees may be charged to Deposit Account No. 111833.

Respectfully submitted,

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